

## 2.1 AQA Extra Questions. (answers at the back)

**Q1.** Organisms can be classified using a hierarchy of phylogenetic groups.

(a) Explain what is meant by:

(2)

(i) a hierarchy

(ii) A student who looked at these results concluded that animals **B** and **C** are more closely related to each other than to any of the other animals.

Suggest **one** reason why this might **not** be a valid conclusion.

(2)

(1)

(ii) a phylogenetic group.

(iii) Cytochrome c is more useful than haemoglobin for studying how closely related different organisms are. Suggest **one** reason why.

(1)

(b) Cytochrome c is a protein involved in respiration. Scientists determined the amino acid sequence of human cytochrome c. They then:

(1)

determined the amino acid sequences in cytochrome c from five other animals.

**Q2.** (a) The scientific name of the leopard is *Panthera pardus*. Complete the table to show the classification of the leopard.

Kingdom		Animalia	
Phylum		Chordata	
The table shows their results.		Mammalia	
Animal		Carnivora	
Number of differences in the amino acid sequence compared with human cytochrome c		Felidae	
Genus			
Species		1	
A			
B		12	
C		12	
D		15	

(2)

(b) Leopards, cheetahs and pumas are all members of the family Felidae.

Biologists used DNA hybridisation to investigate the evolutionary relationships between leopards, cheetahs and pumas. They found that hybrid DNA from a leopard and a cheetah separated into single strands at a higher temperature than hybrid DNA from a leopard and a puma.

(i) Explain how these results suggest that animal **A** is the most closely related to humans. These results suggest that leopards are more closely related to cheetahs than to pumas. Explain why.

.....The crimson topaz and the fiery topaz are hummingbirds.....

.....Biologists investigated whether the crimson topaz and the fiery topaz are different species of hummingbird, or different forms of the same species.

.....They caught large numbers of each type of hummingbird. For each bird they (2)

- recorded its sex
  - recorded its mass
- (c) All modern cheetahs are thought to have descended from a single female. This female was part of a small population that survived an ice age a long time ago that killed almost all cheetahs. After the ice age, the number of cheetahs increased.
- (i) • took a sample of a blood protein.  
Use this information to explain what is meant by a genetic bottleneck.  
The table shows some of their results.

	Crimson topaz		Fiery topaz	
	Male	Female	Male	Female
Mean mass / g ( $\pm$ standard deviation)	13.6 ( $\pm$ 1.9)	10.8 ( $\pm$ 1.3)	14.2 ( $\pm$ 1.6)	11.6 ( $\pm$ 0.63)
Colour of throat feathers	Green	Grey edges	Yellowish green	No grey edges

(2)

- (b) (i) Explain how the standard deviation helps in the interpretation of these data.

- (ii) The fertility of cheetahs is low. The proportion of abnormal sperm cells produced is higher in cheetahs than in other members of the family Felidae. Suggest an explanation for this.

.....  
.....  
.....  
.....  
.....  
.....

(2)

- (ii) In hummingbirds throat colour is important in courtship. Explain the evidence in the table that shows that the crimson topaz and the fiery topaz may be different (Total 2 marks) (2)

**Q3.** Hummingbirds belong to the order Apodiformes. One genus in this order is *Topaza*.

- (a) (i) Name **one** other taxonomic group to which all members of the Apodiformes belong.

.....  
.....

(1)

- (ii) Name the taxonomic group between order and genus.

.....

(2)

(1)

- (c) The biologists analysed the amino acid sequences of the blood protein samples from these hummingbirds.

Explain how these sequences could provide evidence as to whether the crimson topaz

1. and the fiery topaz are different species.....

2.....

3.....

(2)

The diagram shows the phylogenetic relationship between five species of fruit fly that belong to the genus *Drosophila*.

(2)

(Total 8 marks)

- (ii) The biologists measured the temperatures at which the samples of hybrid DNA separated into single strands. Explain why these temperatures could be used to find the percentage of DNA hybridisation.

- (b) (i) Explain what is meant by a phylogenetic relationship.

**Q4.** Cranes are large birds. One of the earliest methods of classifying cranes was based on the calls they make during the breeding season.

- (a) Explain why biologists could use calls to investigate relationships between different species of crane.

(1)

(2)

- (ii) How many million years ago did *D. melanogaster* and *D. pseudoobscura* last share a common ancestor?

(1)

- (c) Biologists can also use protein structure to investigate the relationship between different species of crane. Explain why.

(2)

- (c) Scientists used DNA hybridisation to confirm the relationship between *D. mauritania*, *D. sechellia* and *D. yakuba*.

- (b) More recently, biologists have used DNA hybridisation to confirm the relationships between different species of crane. They made samples of hybrid DNA from the same and from different species. They made samples of hybrid DNA using a gene that was found in all three species. They made samples of hybrid DNA using a gene that was found in all three species. They measured the percentage of hybridisation of each sample.

The results are shown in the table.  
Explain why it was important that they made samples of hybrid DNA from the same gene.

Species of crane from which hybrid DNA was made			Percentage DNA hybridisation
<i>Grus americana</i>	and	<i>Grus monachus</i>	97.4
<i>Grus monachus</i>	and	<i>Grus rubicunda</i>	95.7
<i>Grus americana</i>	and	<i>Grus rubicunda</i>	95.5
<i>Grus rubicunda</i>	and	<i>Grus rubicunda</i>	99.9
<i>Grus americana</i>	and	<i>Grus americana</i>	99.9
<i>Grus monachus</i>	and	<i>Grus monachus</i>	99.8

(2)

(Total 8 marks)

(2)

**Q5.**

- (ii) The hybrid DNA formed between *D. mauritania* and *D. sechellia* separated at a higher temperature than the hybrid DNA formed between *D. mauritania* and *D. yakuba*.  
(a) An order is a taxonomic group. Fruit flies and mosquitoes belong to the same order of insects. Name the other three taxonomic groups to which fruit flies and mosquitoes both belong.

- (b) Which two species seem to be the most closely related? Explain your answer.

Explain what caused the DNA to separate at a higher temperature.

.....

.....

.....

.....

.....

(2)  
(Total 8 marks)

- M1.(a)** (i) 1. Groups within groups;  
     1. *Accept: idea of larger groups at the top / smaller groups at the bottom*  
 2. No overlap (between groups);
- 2

- (ii) (Grouped according to) evolutionary links / history / relationships / common ancestry;  
     *Neutral: closely related*  
     *Neutral: genetically similar*
- 1

- (b) (i) 1. (Only) one amino acid different / least differences / similar amino acid sequence / similar primary structure;  
 2. (So) similar DNA sequence/ base sequence;
- 2

- (ii) 1. Compared with humans / not compared with each other;  
     *Accept: degenerate code / more than one triplet (codes) for an amino acid*  
 2. Differences may be at different positions / different amino acids affected / does not show where the differences are (in the sequence);
- 1 max

- (iii) 1. All organisms respire/have cytochrome c;  
     *Accept: converse arguments for haemoglobin*  
     1. *Accept 'more' instead of 'all'*  
     1. *Accept 'animals' instead of organisms* [9]  
 2. (Cytochrome c structure) is more conserved / less varied (between organisms);  
     2. *Neutral: cytochrome c is conserved*
- 1 max

**M2.(a)**

	Kingdom	Animalia
	Phylum	Chordata
	<b>Class</b>	Mammalia
	<b>Order</b>	Carnivora
	Family	Felidae
	Genus	<b>Panthera</b>
	Species	<b>pardus</b>

*One mark for each correct column*

*Do not award mark for last column if '**Pardus**' is clearly stated*

*Accept: Panthera pardus in final box*

2

(b) (For the leopard and cheetah)

*Accept converse argument for leopard and puma*

1. More hydrogen bonds (form);  
*Neutral: similar DNA*
2. Similar DNA sequence(s) / similar base sequence(s) / more complementary bases / more base pairs;  
*2. Idea of 'more' must be clear*

2

- (c) (i)
1. Drop in population / many killed / only single female left;
  2. Idea of reduced / low genetic variation / diversity / reduction in (variety of) alleles / smaller gene pool;

2

- (ii)
1. Mutation affecting sperm cell or production (in small population);
  2. Errors during meiosis;
  3. Inbreeding / closely related cheetahs breed;
  4. High chance of inheriting allele / high frequency of allele (in the population);  
*4. Accept: high frequency of homozygous / two recessive alleles*

2 max

**[8]**

- M3.** (a) (i) Kingdom / phylum / class;  
*Accept Animalia / animal kingdom / Chordata / Chordates / Aves*  
*Allow phonetic spelling* 1
- (ii) Family; 1
- (b) (i) 1. Shows the spread of the data / how data varies;  
*1. Reject range.*  
*Accept varies from the mean*
2. Overlap = no difference / due to chance / not significant;  
*2. Allow converse*
3. Low SD means results more reliable / repeatable;  
*3. Ignore accurate / valid* 2 max
- (ii) 1. Different colour / different feathers / different throat;
2. Birds don't mate / pair bond with / recognise other species;  
*2. Reference to courtship alone is not sufficient* 2
- (c) 1. Different species would have different amino acid sequences;  
*Accept more closely related = more similar sequence*
2. Amino acid sequence is the result of DNA / alleles / base sequence;  
*References to incorrect statements about coding negates second mark* 2

[8]

- M4.** (a) Is species specific / allows recognition of same species;
- Greater similarity in calls the closer the relationship  
 (between the species);  
*Accept: 'Similar species have similar calls' as first marking point.*  
*Reference to courtship on its own is not sufficient for a mark.*  
*Must refer to relationship for second marking point.* 2

- (b) (i) *G. americana* and *G. monachus*;  
 Highest percentage (DNA hybridisation) / more bases are similar/complementary / more hydrogen bonds / more base pairings;  
*Second marking point can be awarded without first marking point.* 2
- (ii) Higher temperature / more energy (required) the higher the percentage DNA hybridisation / more bases are similar/complementary / more base pairings;  
 Correct reference to breaking hydrogen bonds / more/less hydrogen bonds being present;  
*Accept: 'The greater the number of hydrogen bonds the higher the temperature/more energy required to break them' for one mark.* 2
- (c) 1. More closely related (species) have more similarities in amino acid sequence/primary structure;  
 2. In same protein / named protein e.g. albumin;  
 3. Amino acid sequence is related to (DNA) base/triplet sequence;  
**OR**  
 4. Similar species have a similar immune response to a protein/named protein;  
 5. More closely related (species) produce more 'precipitate' / antibody-antigen (complexes) / agglutination;  
*Accept: 'Similar species have similarities in amino acid sequence' for first marking point.*  
*Accept: Converse for marking points 1, 4 and 5.*  
*Marking point 5 is for measuring the extent of the immune response.* 2 max
- [8]

- M5.** (a) Kingdom, phylum and class;;  
*Lose 1 mark for each error (i.e. omission or incorrect response).*  
*Sequence not essential.* 2
- (b) (i) Shows evolutionary relationship; 1

(ii) 26;

1

- (c) (i) 1. Base sequence will be similar/some bases in common;  
2. These bases will bind together/hydrogen bonds/complementary pairs;  
*Do not accept same here.*  
*Accept converse providing that it is clear that the converse argument is being made.*

2

- (ii) 1. Relationship is closer/more complementary bases/more base pairs;  
2. More hydrogen bonds;  
3. More heat energy needed (to separate bonds);  
*Do not allow stronger hydrogen bonds.*  
*Not higher temperature as this is in question.*

2 max

[8]